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CONSOLIDATED VULTEE

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**DIVISION** San Diego
**MODEL** XFY-1

**REPORT** CVAL 107B
**DATE** 5-14-54

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TITLE

Report CVAL 107B

# ADDITIONAL LOW-SPEED WIND-TUNNEL TESTS OF A POWERED .15 SCALE MODEL OF THE XFY-1 AIRPLANE WITH 57° WING LEADING EDGE SWEEPBACK

(Tested 22 February to 1 March, 1954)
Submitted Under
Navy Contract Noa(s)51-936c

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**REFERENCE** CVAL 107, & 107A

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**NO. OF PAGES** 35

**NO. OF DIAGRAMS**

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DOD DIR 5200.9

**REVISIONS**

| NO. | DATE | BY | CHANGE | PAGES AFFECTED |
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## INTRODUCTION

This report presents data from additional low-speed wind-tunnel tests on a powered .15 scale model of the Convair XFY-1 airplane. The tests were made in the 8- by 12-foot test section of the Convair Wind Tunnel during the period from February 22 through March 1, 1954. A total of 46 hours of wind tunnel time was used under the authorization of Navy Contract NOa(s)51-936c.

The purpose of the tests was to determine the following information:

a. Maximum lift characteristics with and without power, (normal flight).

b. Trim effects of a cambered wing leading edge, an elevon-type trimmer, and delta wing-tip trimmers, (normal flight).

c. Slipstream direction with various crosswind velocities, (hovering flight).

d. Duct pressure recovery characteristics, (normal flight to hovering flight).

The model consisted of the wing with elevons, body, upper and lower vertical tails, four oleo struts, two gun pods, and elevon actuators. A three-view sketch of this configuration is shown on page 5 .

Tests for the maximum lift characteristics were made at a dynamic pressure of 25 pounds per square foot. Tests for trim characteristics were made at a dynamic pressure of 60 pounds per square foot. The corresponding Reynolds Numbers are 2.1 and 5.0 million based on the wing mean aerodynamic chord, 28.284 inches. For tests to obtain duct pressures, the dynamic pressure was varied from 0 to 5 pounds per square foot, with the corresponding Reynolds Numbers ranging from 0 to .42 million based on the wing mean aerodynamic chord. For tests on the slipstream direction, the dynamic pressure was also varied from 0 to 5 pounds per square foot. The ratios of crosswind velocities to propeller slipstream velocities correspondingly range from 0 to .376.

An analysis of the data from the slipstream direction investigation has been prepared by the Convair Aerodynamics Group, and issued as Aero Memo A-5-53.

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## MODEL AND METHODS

The model was mounted on the "L" strut system with the model moment reference center coincident with the tunnel balance center. The basic model consisted of the wing with elevons, body, upper and lower vertical tails, four oleo struts, two gun pods, and aileron actuators as shown in the sketch on page 5. The model wing and tails were made of laminated mahogany over steel spars while the body was formed of laminated fiberglas shells over a steel frame. All other parts were made of mahogany. All exposed model surfaces were painted with grey lacquer and rubbed to a smooth finish. All joints and assembly screw holes were either filled with wax or covered with cellophane tape. The model was considered to be only in fair condition because of the relatively large number of disfigurations such as screw holes and loose joints.

In addition to tests with the basic model as indicated above, several modifications to the wing were tested including cambered wing leading edges, an elevon-type trimmer, and delta wing-tip trimmers. The cambered wing leading edges were made of pine with wax fillets on the joints and rough spots. They are shown in the sketch on page 6 and in the photographs on page 32. The elevon-type trimmers consisted of the outboard 25% of the actual elevon, deflected individually as a trimmer. The delta wing-tip trimmer was formed of sheet aluminum. The elevon and tip trimmers are shown in the sketch on page 7 and in the photographs on page 33.

Testing for the slipstream direction was done with thread tufts attached to the model as shown in the sketch on page 9. For a typical run, the model was set to a given attitude with a given power condition, and then tested through a range of tunnel dynamic pressures of 0 to 5 pounds per square foot. The data was recorded by photographing the model from the roof of the tunnel test section.

Testing for the duct pressure recovery characteristics was done with the setup shown in the photographs on page 34. A special lower half of the fuselage shell was built with tubes emerging from the ducts through the bottom of the shell. These tubes were joined by metal ducting and connected by means of 6 inch diameter rubber tubing to a Buffalo 6E centrifugal blower. The blower was driven by an electric motor rated at 25 horsepower. The pressure measuring instrumentation consisted of total head and static tubes located near the duct entrance as shown in the sketch on page 8. These total head and static tubes were connected, by means of rubber tubing through the tunnel floor, to a manometer board which was photographed to record the data.

Power for the model was supplied by an electric motor, rated at 150 horsepower, driving counter-rotating propellers of 28.8 inch diameter.

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## MODEL AND METHODS (Cont'd)

The motor was lubricated and cooled through oil and water leads fed through the tunnel floor and the hollow mounting struts to the model. The power applied during a run was set by holding a constant value of $T_c'$, or a constant value of rpm, or a constant value of thrust. A run with constant $T_c'$ was made by changing the propeller rpm for each angle of attack. A constant rpm run was made by holding the rpm constant regardless of angle of attack. A run at constant thrust was made by setting the model body force to a value of minus 160 pounds and holding this value constant. The calibration curves showing power and rpm relationships for constant $T_c'$ and constant thrust settings are plotted in figure 1 on page 19.

The tests to determine maximum lift were run at a dynamic pressure of 25 pounds per square foot. Those made to investigate the effects of the elevon-type trimmers and the delta wing-tip trimmers were run at a dynamic pressure of 60 pounds per square foot. The corresponding Reynolds Numbers are 2.1 and 5.0 million based on the wing mean aerodynamic chord, 28.284 inches. For the tests made to determine duct recovery pressures and on the tuft studies investigating slipstream direction, the dynamic pressure varied through 0, 1, 2, 3, 4, and 5 pounds per square foot. The Reynolds Numbers corresponding to these dynamic pressures range from 0 to .42 million based on the wing mean aerodynamic chord. Corrections to dynamic pressure because of tunnel blockage corrections for angle of attack variation were taken from experimental investigations made in CVAL Tests 107 and 107A.

## RESULTS

Six component data were recorded on all force data runs, and have been reduced to coefficient form. Lift and pitching moment data are presented in figures 2, 3, and 4 showing maximum lift characteristics with various power and elevon settings. Lift, drag, and pitching moment data are presented in figures 5, 6, and 7 showing effects of cambered wing leading edges, and elevon and delta wing-tip trimmers.

The duct pressure recovery data has been reduced to the form of velocity ratios and are presented in figures 8, 9, and 10. The duct pressure recovery characteristics are presented with figure 8 containing data with propellers off, figure 9 containing data with power settings of 160 pounds of thrust, and figure 10 containing data showing the effects of propeller slipstream. The velocity ratios presented are (1) the ratio of the velocity inside the air inlet duct to the velocity of the slipstream just forward of the duct, and (2) the ratio of the tunnel velocity to the theoretical propeller slipstream velocity at infinity as determined from the Momentum Theory.

## RESULTS (Cont'd)

Data obtained from the slipstream direction investigation are not presented in this report. The data photographs, however, are on file at the Convair Wind Tunnel. The data has been analyzed by the Convair Aerodynamics Group and is available in Aero Memo A-5-53.

For the force data, lift and drag coefficients are based on wing area, while pitching moment coefficients are based on wing area and mean aerodynamic chord. All force coefficients are referred to stability axes through a moment reference center located horizontally at the 14% station of the wing mean aerodynamic chord, and vertically as shown in the sketch on page 5 . No aerodynamic tares were applied to the data in this test. Tunnel wall corrections, based on unswept wing theory, have been applied to the data according to the method outlined in the Convair Wind Tunnel Handbook, Volume II, ZA-228.

Page 5 is a photograph
Additional copies of these photos can be obtained through the wind tunnel.

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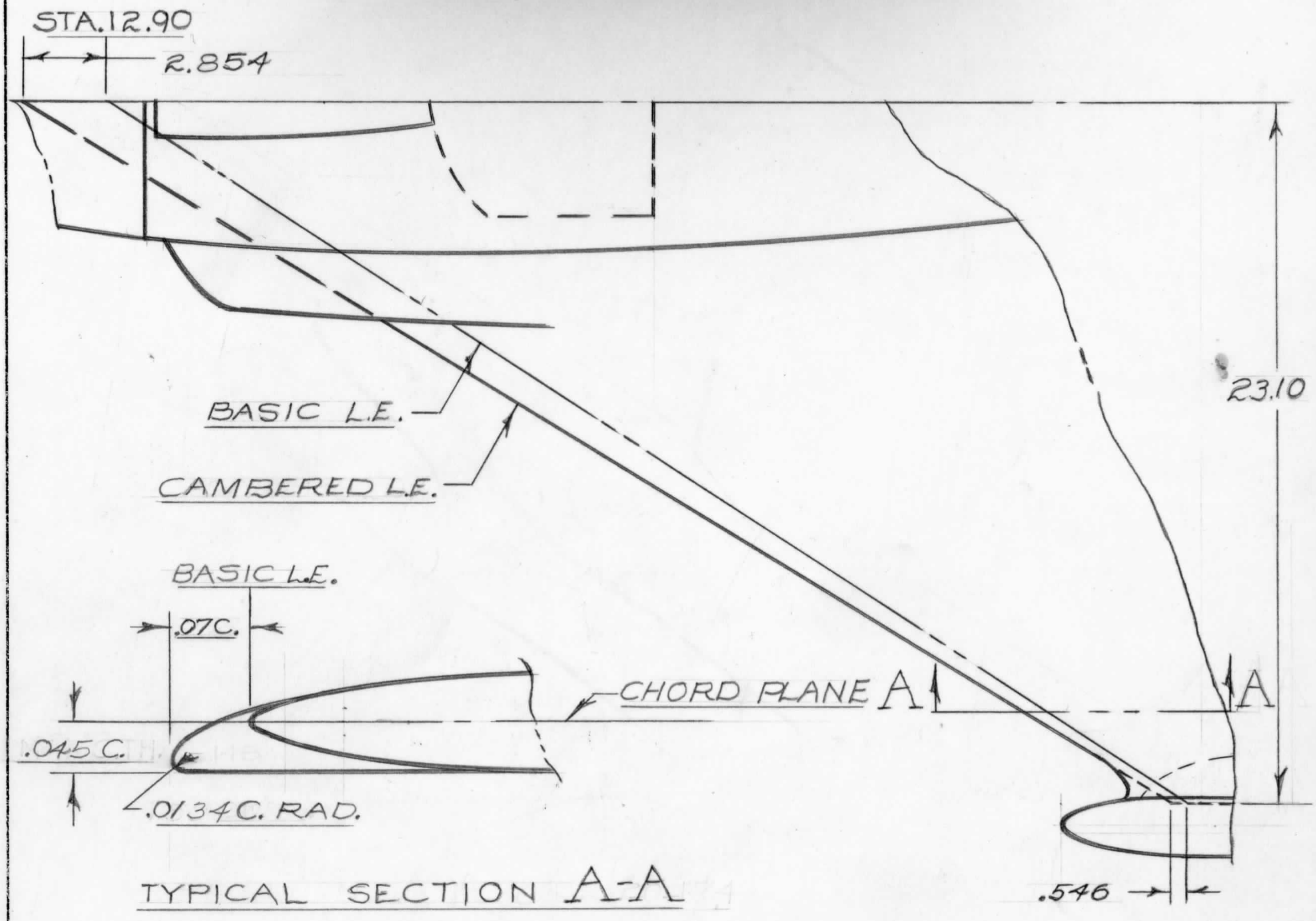

NOTE:

ALL DIMENSIONS IN INCHES MODEL SCALE

CAMBERED WING LEADING EDGE

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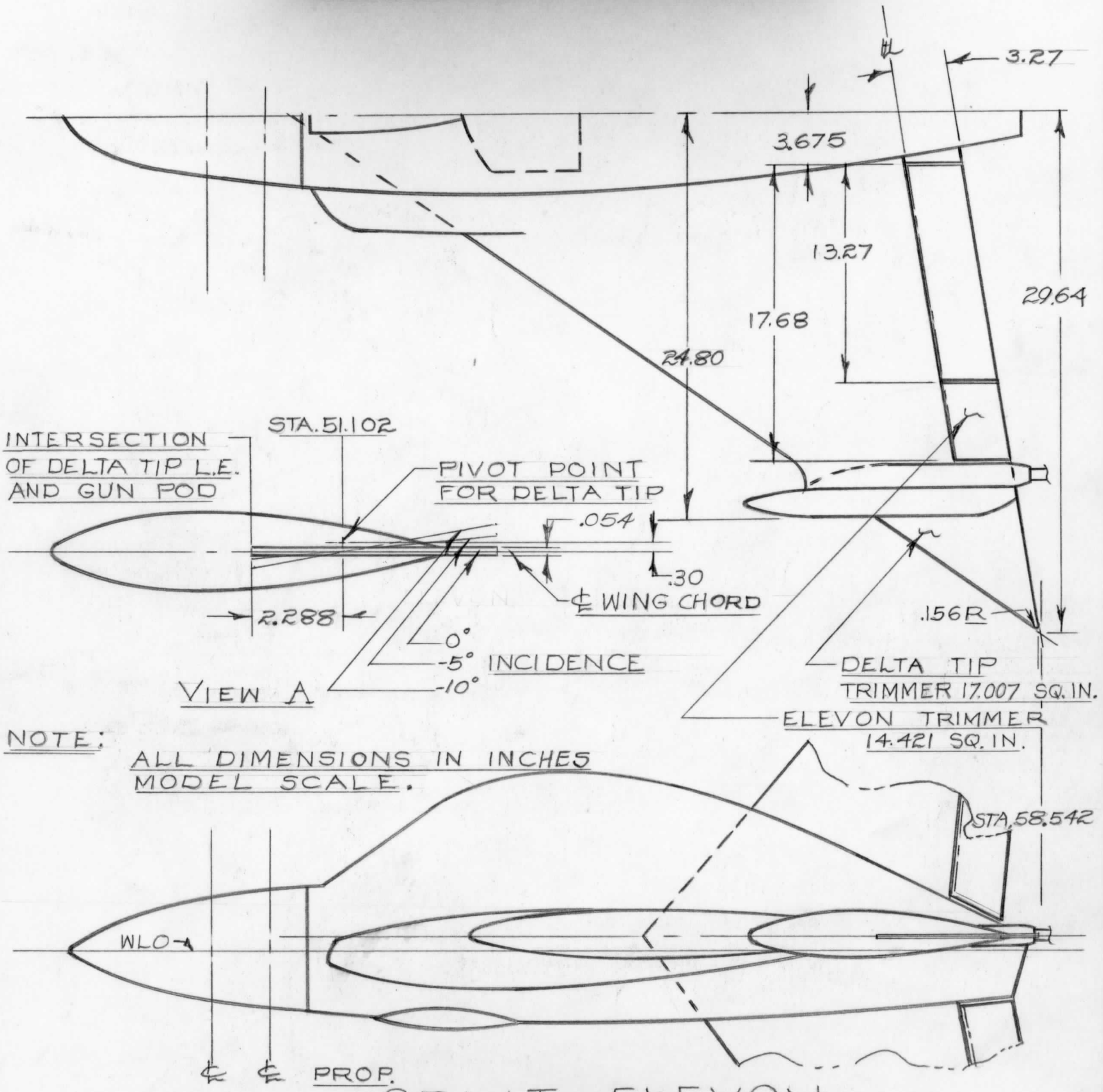

# SPLIT ELEVON
# AND
# DELTA TIP TRIMMERS

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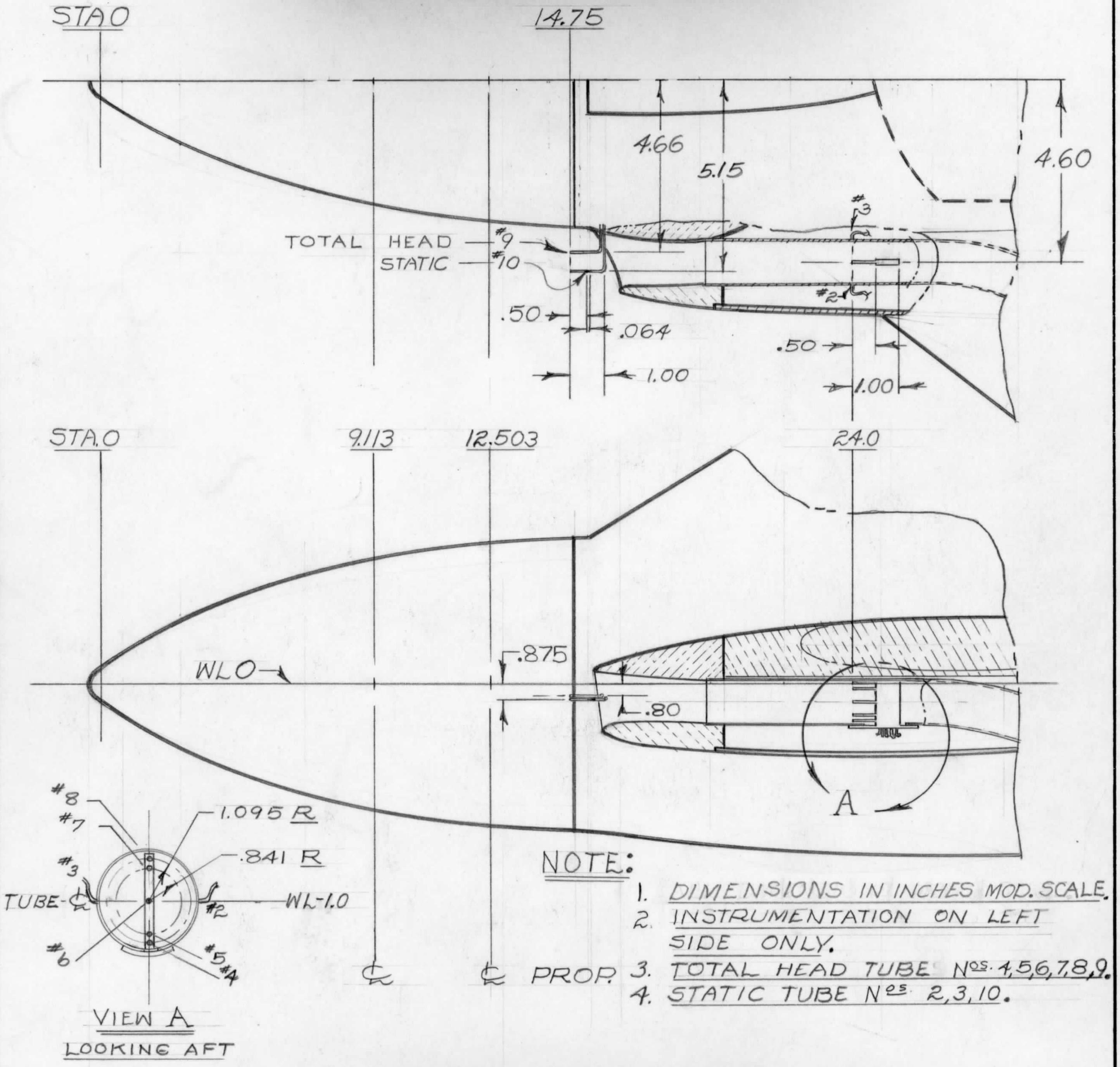

NOTE:

1. DIMENSIONS IN INCHES MOD. SCALE.
2. INSTRUMENTATION ON LEFT SIDE ONLY.
3. TOTAL HEAD TUBE Nos. 4,5,6,7,8,9.
4. STATIC TUBE Nos. 2,3,10.

PRESSURE TUBE LOCATIONS

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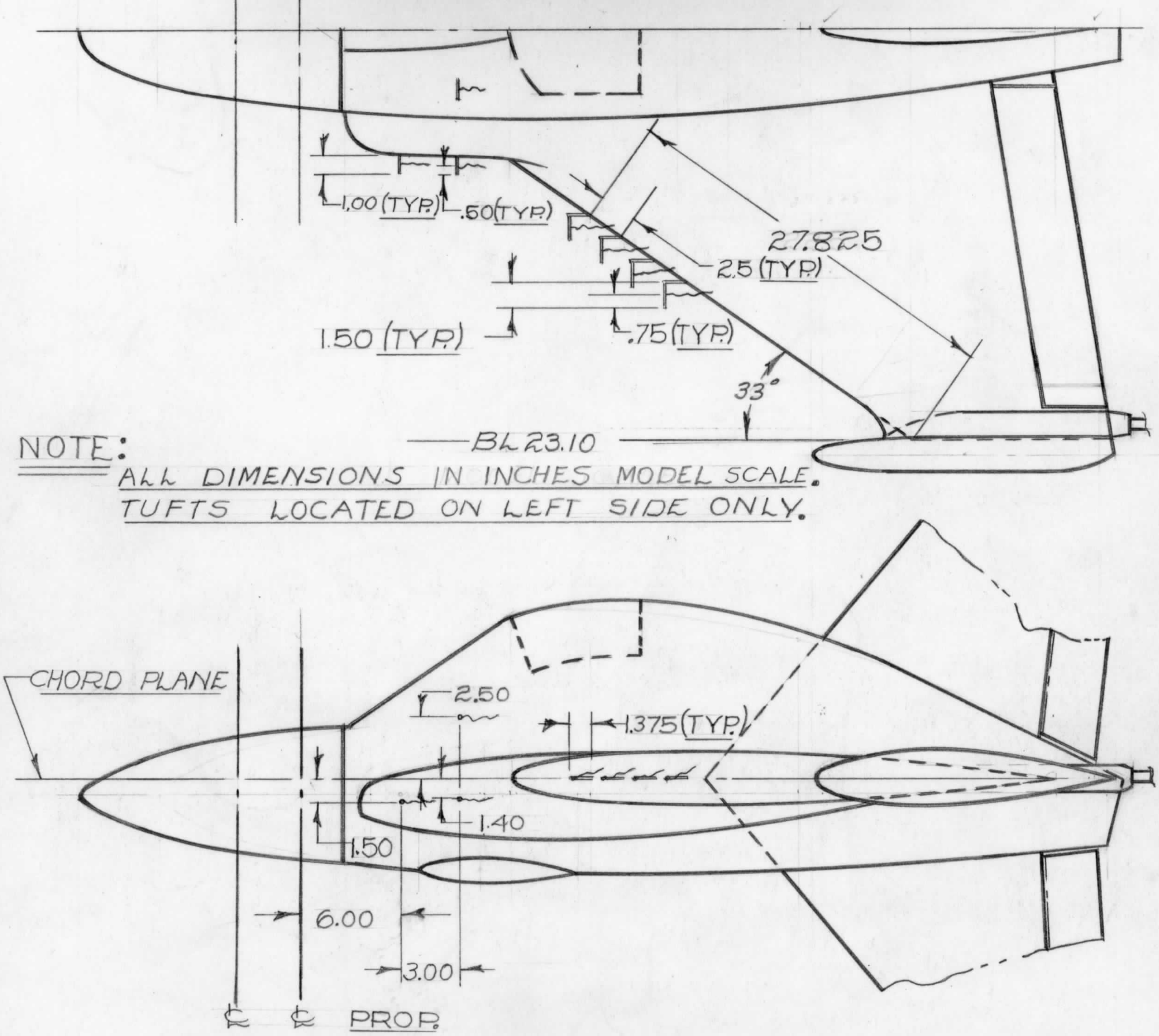

NOTE:
ALL DIMENSIONS IN INCHES MODEL SCALE.
TUFTS LOCATED ON LEFT SIDE ONLY.

TUFT LOCATIONS

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## DESCRIPTION OF MODEL COMPONENTS

| Symbol | Description | Ref. Page No. | CVAC Dwg. No. |
|---|---|---|---|
| $S_3$ | Airplane model including wing with elevons, body, upper and lower vertical tails, four oleo struts, two gun pods, and elevon actuators. Same as model $S_3$ of CVAL Test 107. | 5,30 | WT-51-5022<br>elevons X |
| $S_7$ | Airplane model same as $S_3$ except with open air ducts for internal airflow. Superscript 0 indicates canopy is in the open position. | 8,34 | WT-51-5022 |
| $S_8$ | Airplane model same as $S_3$ except with cambered wing leading edge. | 6,32 | WT-51-5026 |
| T | Delta wing tips outboard of gun pods. | 7,33 | |
| P | Front and rear propellers. | 5,31 | WT-51-5029 |
| $S_p$ | Stovepipe image of model support system windshield. | | |
| Tufts | Short lengths of cotton thread taped to the model to indicate direction of airflow over the model. | | |

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